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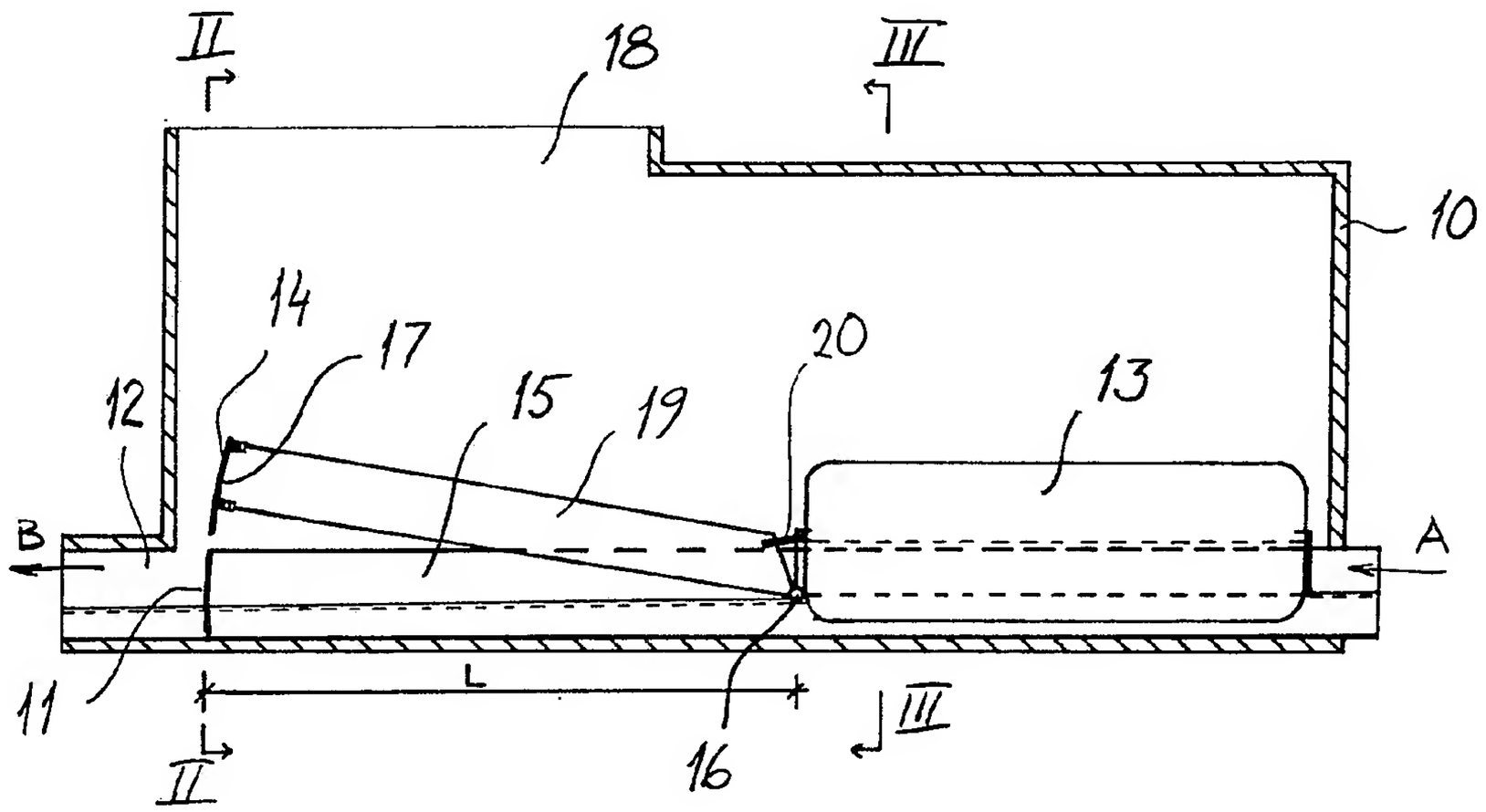
(54) Title: METHOD AND DEVICE FOR CONTROLLING A FLOW OF FLUID



(57) Abstract

The method relates to a method and a device for controlling the flow of a liquid. In a well (10) having at least one inlet (11) and one outlet (12) the area of said inlet (11) is adjusted in dependence on the liquid level in said well (10) by a floating body (13) controlled by said level. Said well is provided with an inlet tube (15) ended by said inlet (11), and at least one outlet (12), a floating body (13) arranged movable in a vertical direction in said well (10), and a slide (14) arranged in said well (10) in front of said outlet (12), said inlet tube (15) and said slide (14) being movable in relation to each other in dependence of a movement of said floating body (13) so as to close adjustably by said slide said inlet (11) of said inlet tube (15).

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METHOD AND DEVICE FOR CONTROLLING A FLOW OF FLUID.

The invention relates to a method and a device according to the preamble of claim 1 and the preamble of claim 3, respectively.

The sewage disposal system in practically all populated areas can functionally be regarded as combined systems, i.e. surface water in the form of for example rain and waste water is transported in the same pipe. Thus the flow in the pipes and the sewage system can markedly increase and exceed the capacity of the sewage system or the sewage treatment plant in case of for example heavy rain. Water has then to be diverted without actual sewage treatment, i.e. being overflowed.

Since an actual control of the flow in the sewage pipes does not exist the overflow occurs without control and wastewater may reach small waters which can be very sensitive to this discharge. A considerable increase in flow in the form of shock load may also cause large problems at sewage plants. The sedimentation and the nitrogen purification are for example affected by disturbances during heavy sludge escape which takes place if the flow is too large.

By controlling the flow by means of devices for flow control at suitable points in the sewage system in order to vary the flow between zero flow and the full capacity of the pipes the flow can be adjusted or directed in a controlled way to for example a depot. Then overloading in both sewage systems and sewage treatment plants can be avoided and very large environmental and economical effects and advantages can be achieved.

In order to avoid large flows in surface water pipes, for example after a cloud burst, devices have previously been suggested which comprise a well or a tank in which

some kind of suction siphon is disposed. Since the flow through the suction siphon is limited a control of the outgoing flow from the well or the tank is effected. Such a process and such a device is shown and described in SE-B 370 430. Similar devices which make use of whirl chambers have also previously been used for flow control. It is also possible to mechanically control all orifices or spillways manually or by means of a engine. An exactly controlled flow from devices which work in this way with pipe or orifice openings or by means of spillway is achieved by varying the area of the orifice or the height of the spillway dependent on the pressure head. This is, however, complicated and requires complicated control devices. The outflow of whirl chambers is also controlled by the static pressure head and when the pressure head is varying it is not possible to keep the outflow constant.

One purpose of the present invention is to achieve a method and a device for flow control, the flow control being controlled independent of the pressure head in the liquid supplying tubes. Flow control should take place automatically in dependence on the liquid level without any help from engines or the like.

This purpose is achieved by the invention having obtained the characterizing features of claim 1 and 3, respectively.

Further advantages are achieved with further developments of the invention, which are defined in the independent claims.

The inventions will now be further described by means of embodiments, reference being made to the accompanying drawings in which

Fig 1 is a side view partly in cross section of the device according to the invention,

Fig 2 is a cross sectional view along the line II-II in Fig 1,

Fig 3 is a cross sectional view along the line III-III in Fig 1,

Fig 4 is a side view partly in section of the device according to the invention at a slightly raised water level in relation to Fig 1-3,

Fig 5 is a cross sectional view along the line V-V in Fig 4,

Fig 6 is a cross sectional view along the line VI-VI in Fig 4,

Fig 7 is a side view partly in section of the device according to the invention with maximal raised water level,

Fig 8 is a cross sectional view along the line VIII-VIII in Fig 7,

Fig 9 is a cross sectional view along the line IX-IX in Fig 7,

Fig 10 is a simplified side view of an alternative embodiment according to the invention at low water level,

Fig 11 is a simplified cross sectional view along the line XI-XI in Fig 10,

Fig 12 is a simplified side view partly in section according to Fig 10 at a slightly raised water level,

Fig 13 is a simplified cross sectional view along the line XIII-XIII in Fig 12,

Fig 14 is a simplified side view partly in section of the device according to Fig 10 at maximal raised water level,

Fig 15 is a simplified cross sectional view along the line XV-XV in Fig 14,

Fig 16 is a side view partly in section of an additional embodiment of the device according to the invention,

Fig 17 is a cross sectional view along the line XVII-XVII in Fig 16, and

Fig 18 is a cross sectional view along the line XVIII-XVIII in Fig 16.

As shown in Fig 1, the device according to the invention comprises a well 10. The well 10 is cylindrical and arranged lying and comprises an orifice 18 made in the envelope surface of the cylinder, which enables occular examination and control of the device positioned in the well.

An inlet tube 15 is extending through substantially all the length of the well. The inlet tube has an inlet 11 which in the embodiment shown in Fig 1 is disposed close to an outlet 12 of the well and at the bottom of the well. An elongated floating body 13 is arranged above the inlet tube 15. The floating body has an inside recess, the shape of which essentially corresponds to the shape of the inlet tube so that the inlet tube 15 is partly received in the recess. The bottom surface of the floating body is curved for adjustment against the internal cylindrical shape of the well, as is best shown in Fig 3. A slide 14 is connected to the floating body 13 through an elongated arched arm 19 so that an obtuse angle is formed between the longitudinal direction of the floating body 13 the longitudinal direction of the arm 19. The angle is adjustable by means of a screw 20. The floating body 13 and the arm 19 are jointly pivotable in a vertical plane in the longitudinal direction of the well 10 around a pivoting axis 16 arranged in the connecting point between the arm 19 and the floating body 13. The slide 14 is a substantially rectangular bent plate, the lower side of which is curved with the same radius as the bottom of the well 10 and the concave side of which is faced towards the pivoting axis 16. The inlet 11 of the inlet tube 15 is constructed with the corresponding shape so that the slide 14 lies close to the inlet 11 during the pivoting movement of the arm 19 around the pivoting axis 16. The radius of the concave surface 17 and of the inlet 11 corresponds to the distance between the pivoting axis 16 and the central point of the inlet 11. The

pivoting axis 16 is arranged on the central line of the inlet tube 15. In this embodiment the water in the well flows in the direction of the arrow A and out of the well in the direction of the arrow B. If the inlet tube 15 is arranged above the bottom of the well 10 the shape of the slide 17 can be chosen more independent. By making the concave surface 17 as a circular sector with its radius corresponding to the distance between the pivoting axis 16 and the central point of the inlet 11 an increased pressure in the inlet tube is secured, which results in a creation of a radially directed force against the slide 14 so that the slide 14 is not pivoted. The arm 19 can also be made of several, for example three, tubes or bars and instead of being curved it can be made as an angle iron or the like.

As is evident from Fig 2 and 3, the water level of the well 10 is so low that the floating body rests against the bottom surface of the well 10 and the total area of the inlet 11 of the inlet tube is available for influx of liquid. By adjusting the screw 20 the obtuse angle between the floating body 13 and the arm 19 can be adjusted so that the characteristics of the device according to the invention are obtained.

Figs 4-6 show a well according to Figs 1-3 with an increased water level compared with the previous figures. As is especially evident from Fig 6 the water level is raised, the floating body 13 being lifted up from its earlier state of rest against the bottom of the well. Since the floating body 13 is pivoted around the pivoting axis 16 the lifting of the floating body 13 takes place in a pivoting movement around the axis 16. Then the arm 19 will follow the pivoting movement in order to move the slide 17 downwards over the inlet 11 of the inlet tube. As is evident of Fig 5, about half the area of the inlet 11 of the inlet tube is covered by the slide 14. By the decrease

of the area of the inlet opening 11 the flow into the well is also decreased in a predetermined way.

At a further raised water level in the well 10, which is shown in Figs 7-9, the floating body 13 has been lifted so high that the arm 19 has been pivoted to its lowest position, in which the slide 14 completely covers the inlet 11 of the inlet tube 15. Thereby further influx of liquid into the well 10 is prevented until the water level again is lowered to a lower level. By the method and device according to the invention it is guaranteed that the flow of the well never exceeds the present capacity downstream the well and that an increasing pressure line upstream the well 10 is not transferred to constructions downstream the well 10.

Figs 10 and 11 show an alternative embodiment according to which a terminating portion of the inlet tube 15 is connected to the remaining portion of the inlet tube 15 by an elastic casing 20. A ring element 21, which is transformed into a clamp 22, surrounds one end of the terminating porting of the inlet tube 15. The clamp 22 is by pivoting axes 16 connected with a corresponding ring 33 of the remaining portion of the inlet tupe 15. The floating body 13 is constructed with substantially the same shape as in the earlier described embodiment according to Figs 1-9 and is disposed on the terminating part of the inlet tube 15, the inlet or opening 11 of which is shaped in the same way as in the earlier described embodiment. In the embodiment shown in Figs 10 and 11 the slide 17 is securedly arranged in relation to the terminating portion of the inlet tube 15. The slide 17 is adjustable by adjustment screws 24 and is constructed with a concave surface 17 facing the terminating portion of the inlet tube 15. Also in this embodiment the radius of the concave surface 17 and the inlet 11 of the inlet tube is equal to the distance between the pivoting axes 16 and the central point of the

inlet 11, and the pivot axes 16 are arranged in the horizontal line of the inlet tube 15. The casing 23 is made of rubber or other such elastic material which can endure the present environment for the application in question. The clamp 22 contributes to the guiding of the pivoting movement of the terminating part of the inlet tube 15 so that the pivoting movement will substantially take place in a vertical plane.

Figs 12 and 13 show the embodiment of Figs 10 and 11 with a somewhat raised water level, the terminating portion of the inlet tube 15 is pivoted upwards around the pivoting axes 16 by the lifting of the floating body 13. Since the floating body 13 is fixedly connected with the inlet tube 15 it will also be pivoted upwards, its inlet 11 being partly pushed over the fixed slide 24. Thereby the inlet area is reduced so that the influx of liquid to the well 10 is reduced.

Figs 14 and 15 refer to the same embodiment as Figs 10-13 with a maximal hight of the water level in the well 10. Then the water level is so high that the floating body 13 and thus the inlet tube 15 are pivoted upwards to such a level that the inlet 11 of the inlet tube is completely covered by the slide 24. Additional liquid is then prevented from flowing into the well 10.

A third embodiment of the device according to the invention is shown in Figs 16-18. In this embodiment the inlet tube is made so as to completely extand through the well 10 in the longitudal direction thereof. However, at the top the inlet tube 15 is about half way cut-off in its extension length of the well 10. The slide 17 is secured in an arm 19 which is pivotable around a pivoting axis 16. The floating body 13 is connected to the arm 19 via an adjustment screw 20 while forming a obtuse angle between the longitudal direction of the floating body 13 and the longitudal direction of the arm 19. When the floating body 13 is

pivoted upwards by the raising water level in the well 10 the arm 19 will be pivoted downwards to a corresponding extent, the slide 17 gradually closing the inlet 11 of the inlet tube 15. Figs 17 and 18 are in principle cross sectional views of the embodiment shown in Fig 16.

In an embodiment not shown the shearing of the inlet tube only extends over the length of the floating body and only a slit is cut out in the inlet tube 15 for receiving the slide 17. Instead of cutting off the inlet tube 15 it is also possible to make perforations in the inlet tube for letting in liquid into the well when the outflow is too low and the pressure line is increasing so that the floating body is raised.

Within the scope of the invention as it is defined in following claims are also alternative combinations of a fixed/movable slide and a fixed/movable inlet tube. It is for example possible to arrange the floating body 13 for a upward and downward movement while a movable slide is conveid. The floating body 13 can also have another shape and for example extend only over a small portion of the inlet tube. Moreover, the floating body 13 can be furnished with means for adjusting its mass in order to accomodate the lifting capacity thereof. In an embodiment not shown a floating body 13 is provided with a cavity which is filled with liquid of such a volume that the desired properties are obtained. It is also suitable that the slide 17 is provided with adjusting means in order to achieve the desired sealing between slide and inlet tube. The shape of the slide can also be varied depending on the application and the desired properties of the device. As is for example evident from Fig 11, the plane slide 17 can be construced with a semicircular recess with substantially the same diameter as the inlet tube 15. In the embodiment according to Fig 18 the movable slide 17 is constructed with a terminating partly circular shaped section with the same diameter

as the inlet tube 15, which is lowered into the cut-off inlet tube 15 as the water level in the well 10 is raised.

CLAIMS

1. Method for controlling the flow of a liquid, c h a r a c t e r i z e d in that a well (10) having at least one inlet (11) and at least one outlet (12) the area of said inlet (11) is adjusted in dependence of the liquid level in said well (10) by a floating body (13) controlled by said level.

2. Method as in claim 1, c h a r a c t e r i z e d in that the floating body (13) is controlled by a pivoting movement.

3. Device for controlling the flow of a liquid, c h a r a c t e r i z e d by a well (10) having at least one inlet tube (15) with a terminating inlet (11) and at least one outlet (12), a floating body (13) vertically movable within said well (10) and a slide (14) disposed in front of said outlet (12) in the well (10), said inlet tube (15) and said slide (14) being movably disposed in relation to each other in dependence of a movement of said floating body (13) for variable closure by said slide (14) of the inlet (11) of the inlet tube (15).

4. Device as in claim 3, c h a r a c t e r i z e d by said slide (14) being movably disposed and operatively connected with said floating body (13) and at least one part of said inlet tube (15) facing said slide (14) being fixedly arranged in said well (10).

5. Device as in claim 4, c h a r a c t e r i z e d by said slide (14) and said floating body (13) being movably disposed around a pivoting axis (16).

6. Device as in claim 5, c h a r a c t e r i z e d by said slide (14) and said floating body (13) being disposed on diametrically opposed sides of said pivoting axis (16).

7. Device as in claims 5 or 6, c h a r a c t e r i z e d by

a surface (17) of said slide (14) facing said inlet (11) of said inlet tube (15) being concave with a curvature, the radius of which corresponds to the distance between said surface (17) and said pivoting axis (16) and

said inlet (11) being made with a curvature, the radius of which corresponds to the distance between said surface (17) and said pivoting axis (16).

8. Device as in claim 3, c h a r a c t e r i z e d by

said slide (14) being fixedly arranged in said well (10), and

at least one part of said inlet tube (15) facing said slide (14) being disposed movably and operatively connected with said floating body (13).

9. Device as in claim 8, c h a r a c t e r i z e d by

said floating body (13) and said part of said inlet tube (15) facing said slide (14) being movably disposed around a pivoting axis (16).

10. Device as in claim 9, c h a r a c t e r i z e d by

a surface (17) of said slide (14) facing said inlet (11) of said inlet tube (15) being made with a curvature, the radius of which corresponds to the distance between said surface (17) and said pivoting axis (16), and

said inlet (11) being made with a curvature, the radius of which corresponds to the distance between said surface (17) and said pivoting axis (16).

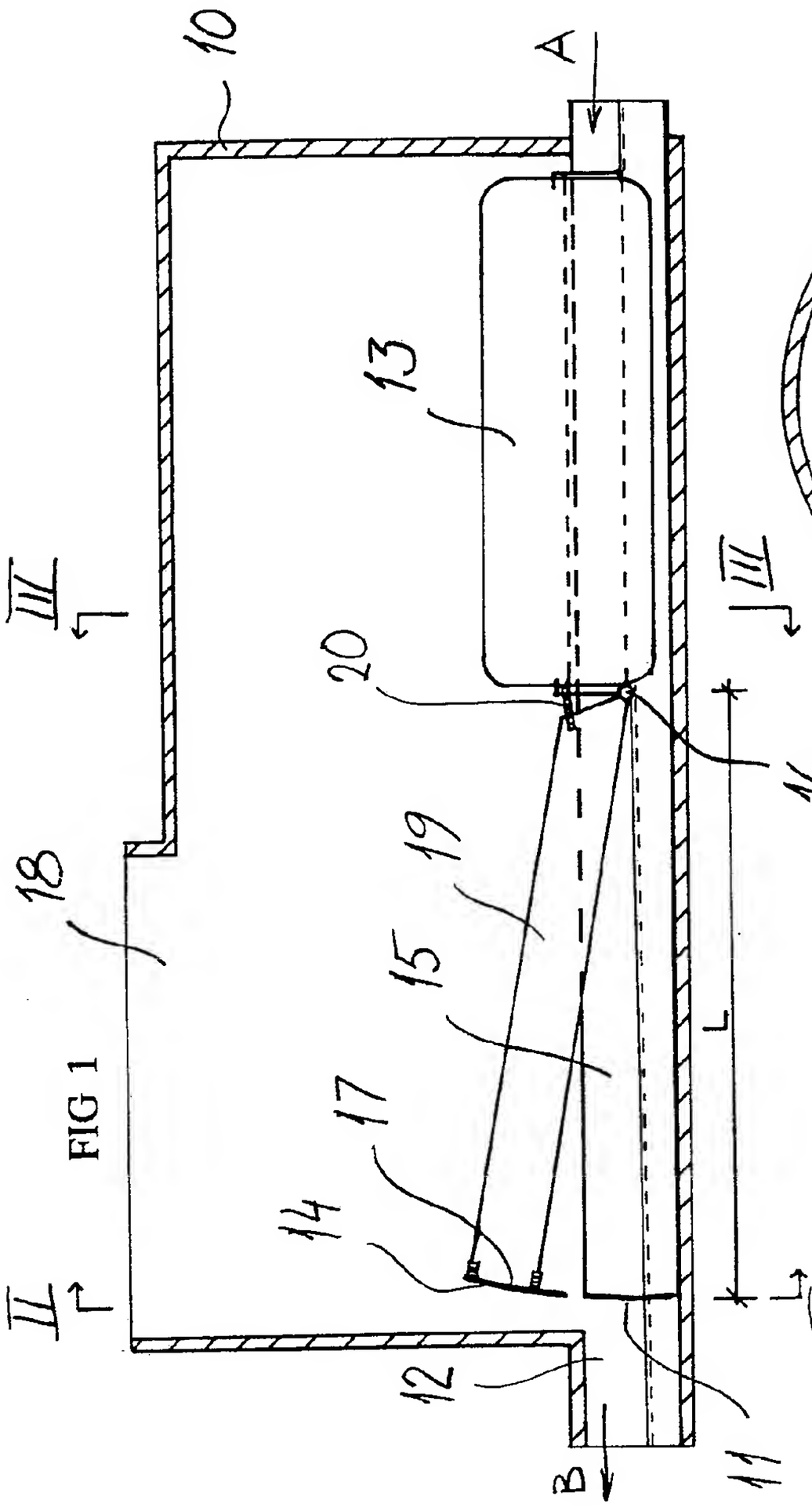

FIG 1

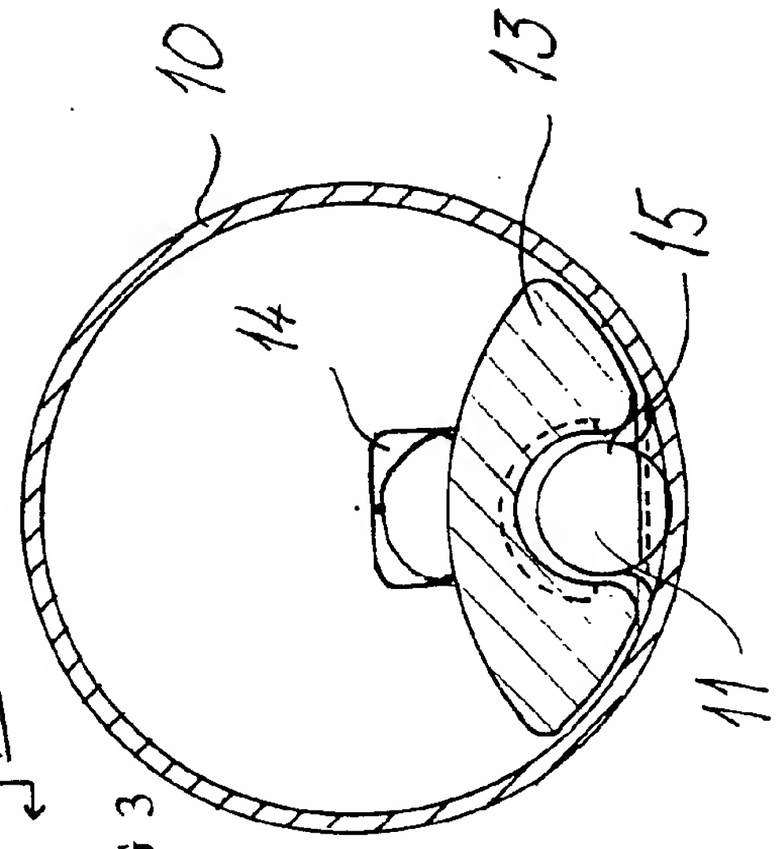

FIG 3

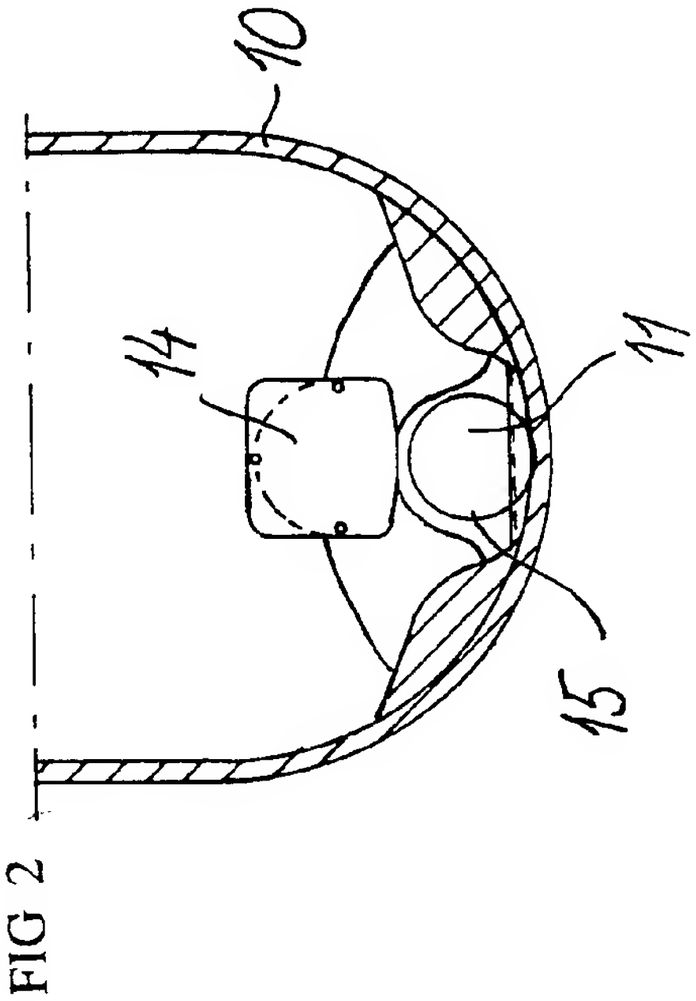

FIG 2

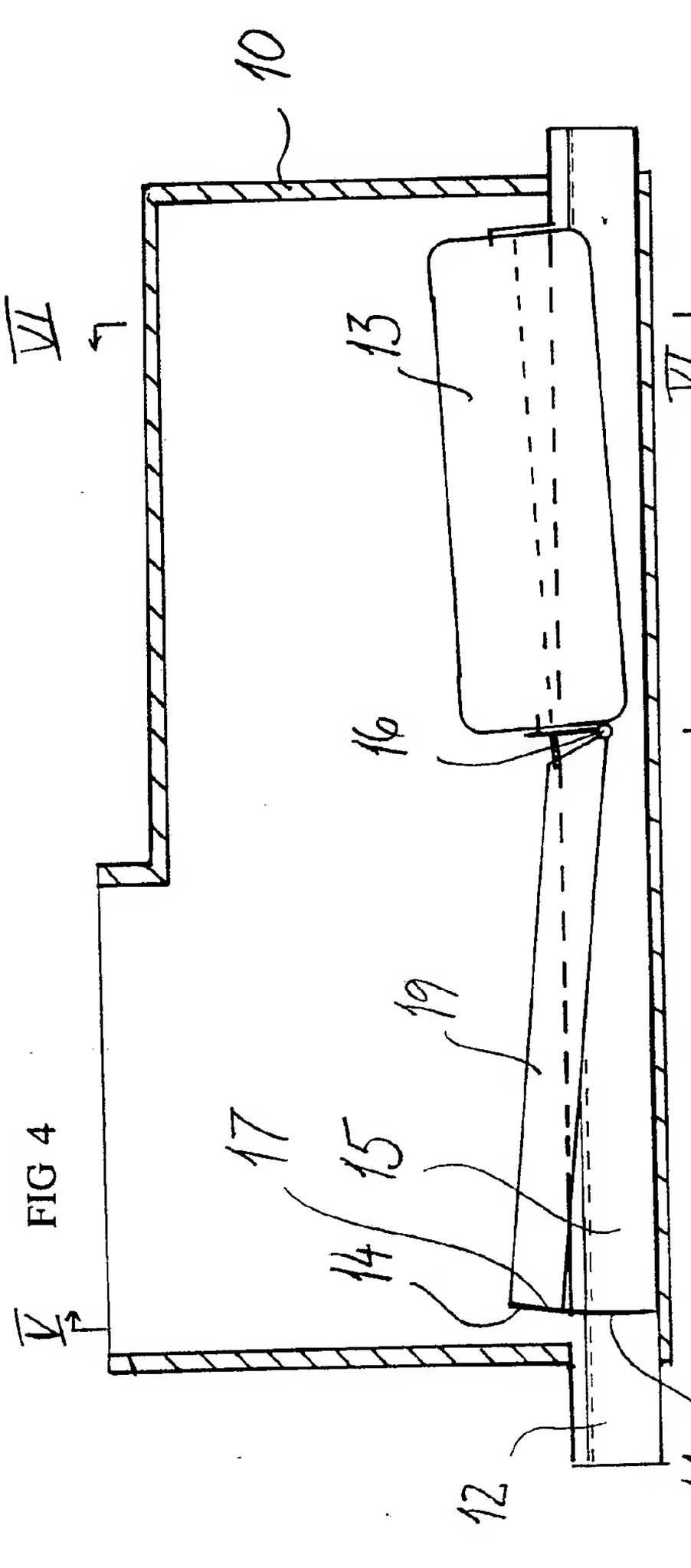

FIG 4

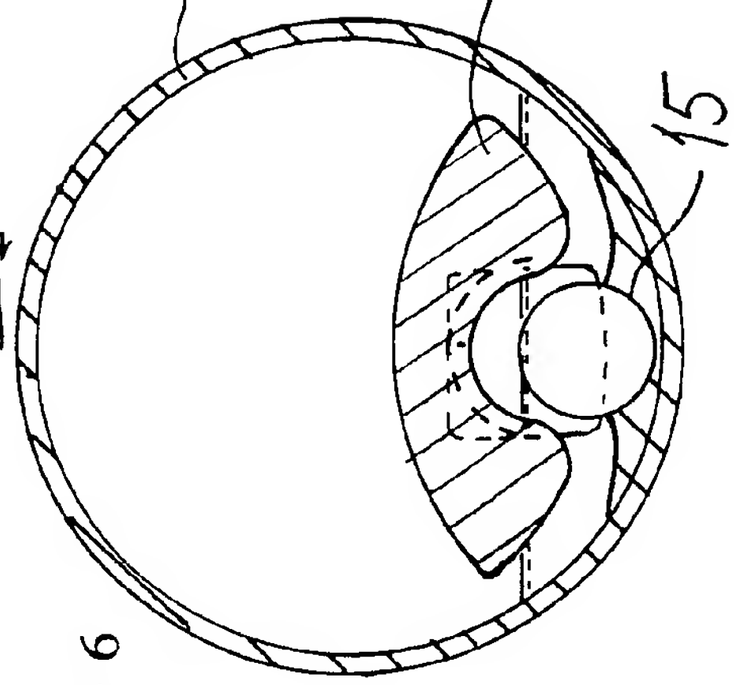

FIG 6

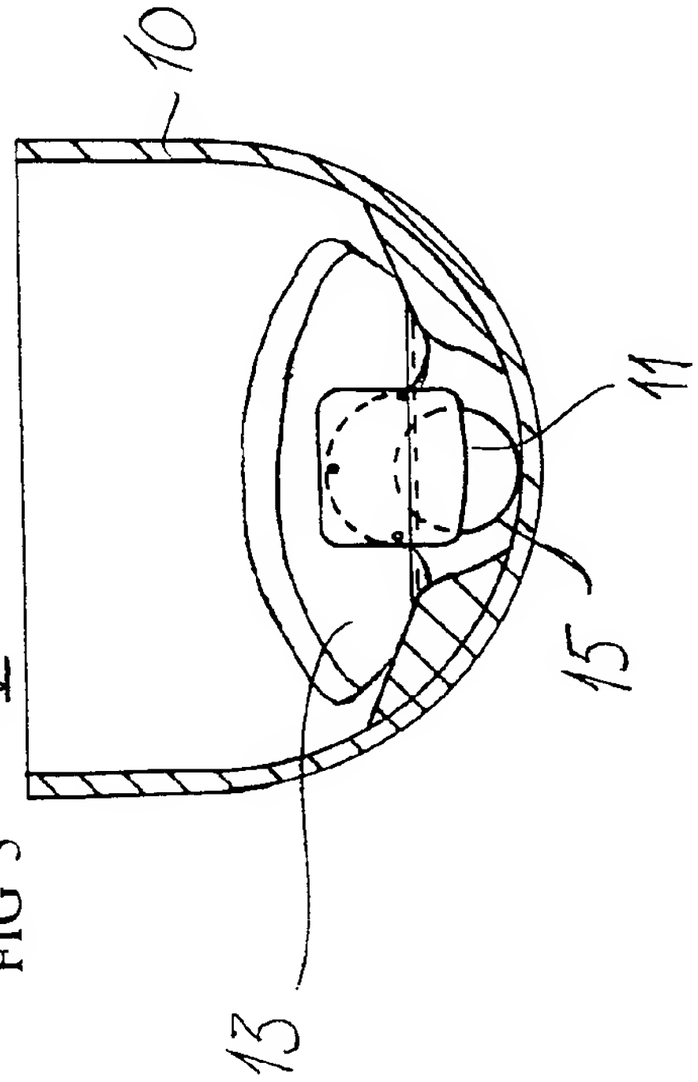

FIG 5

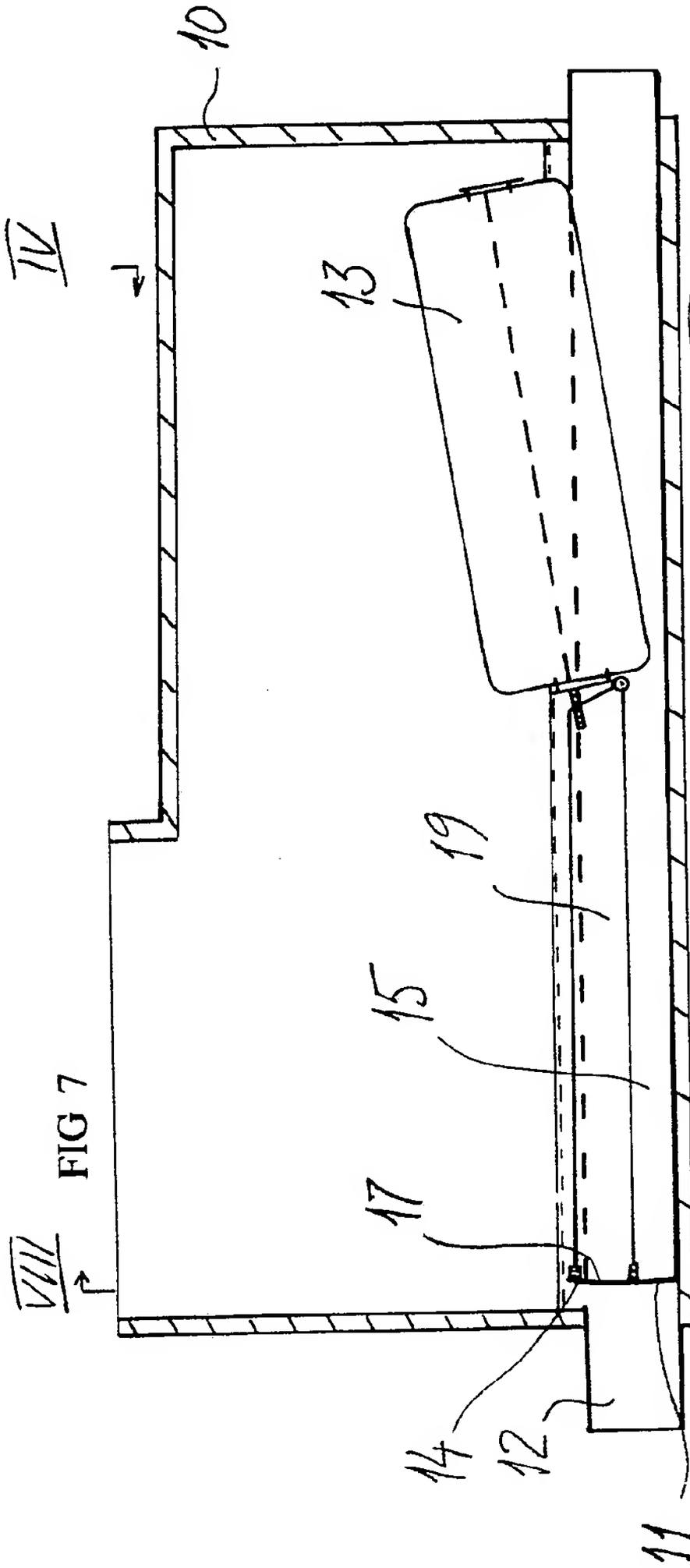

FIG 7

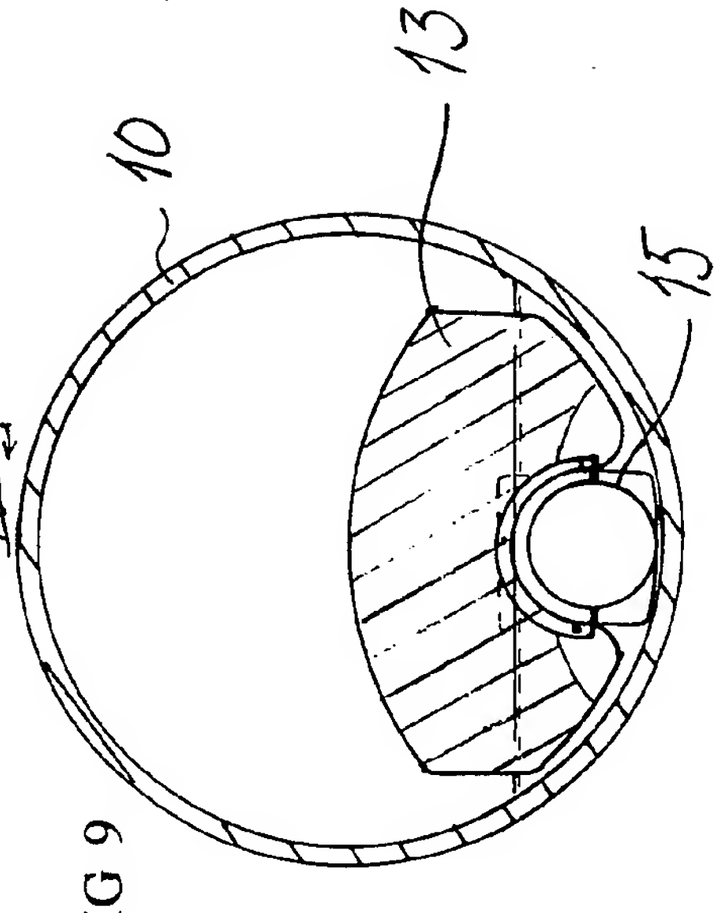

FIG 9

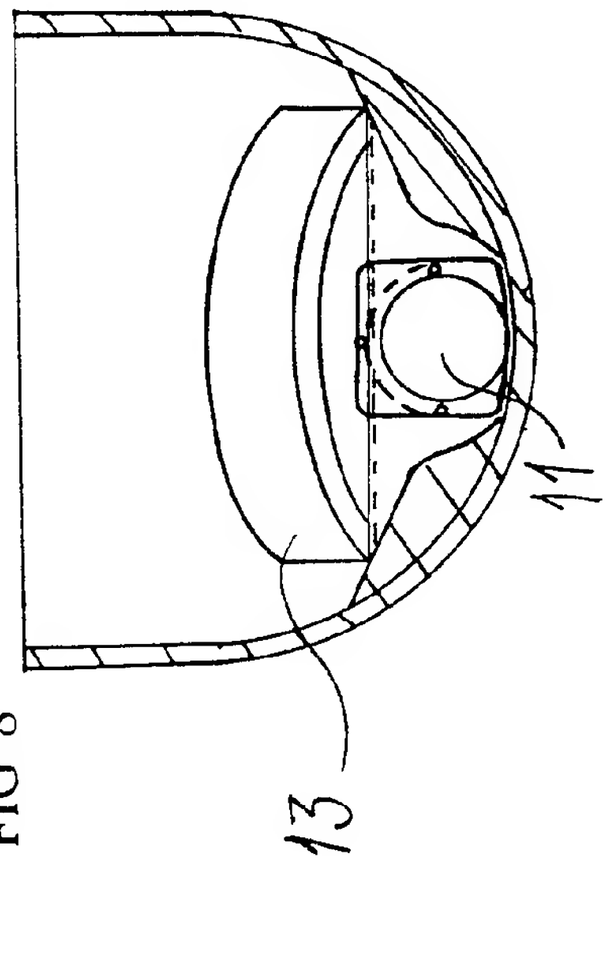

FIG 8

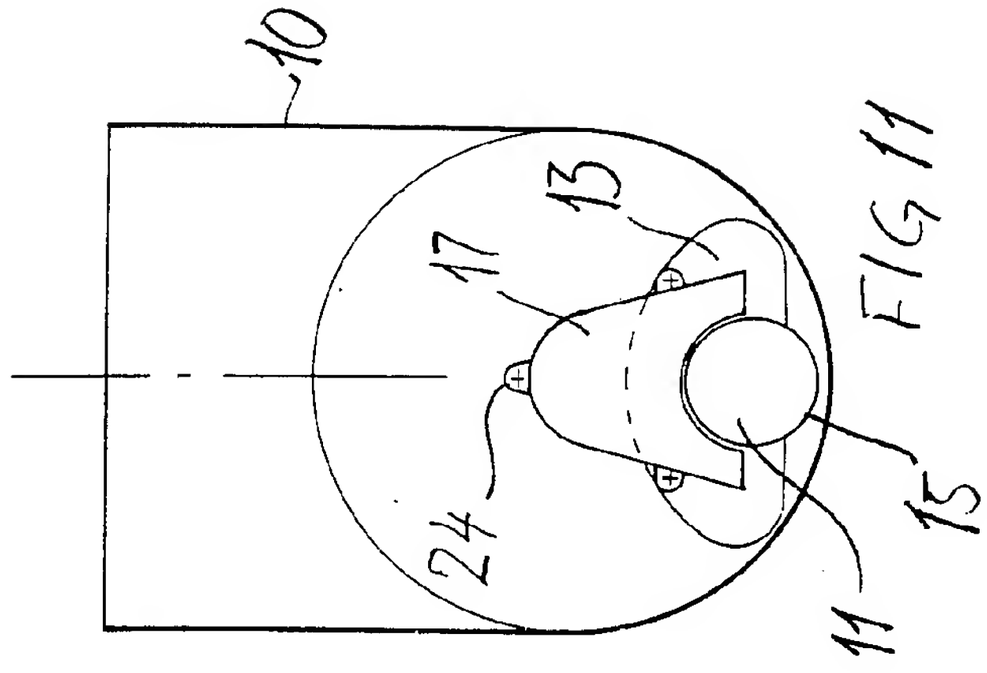

FIG 11

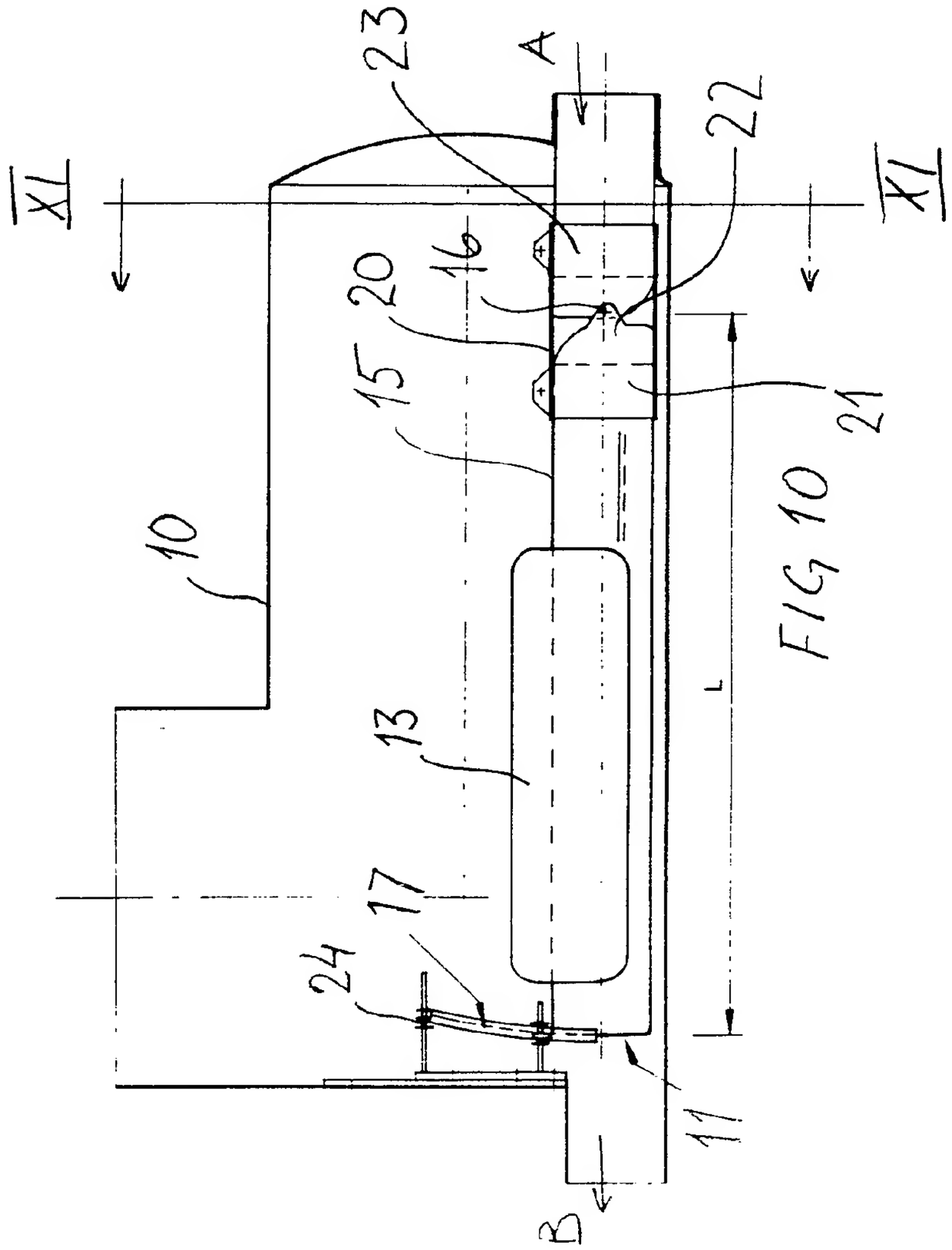

FIG 12

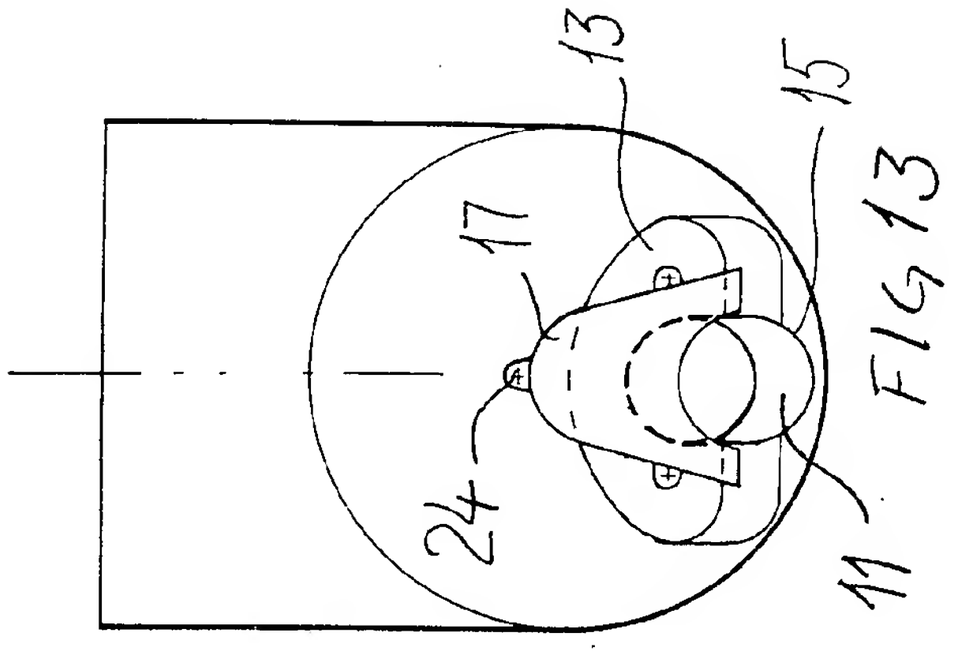

FIG 13

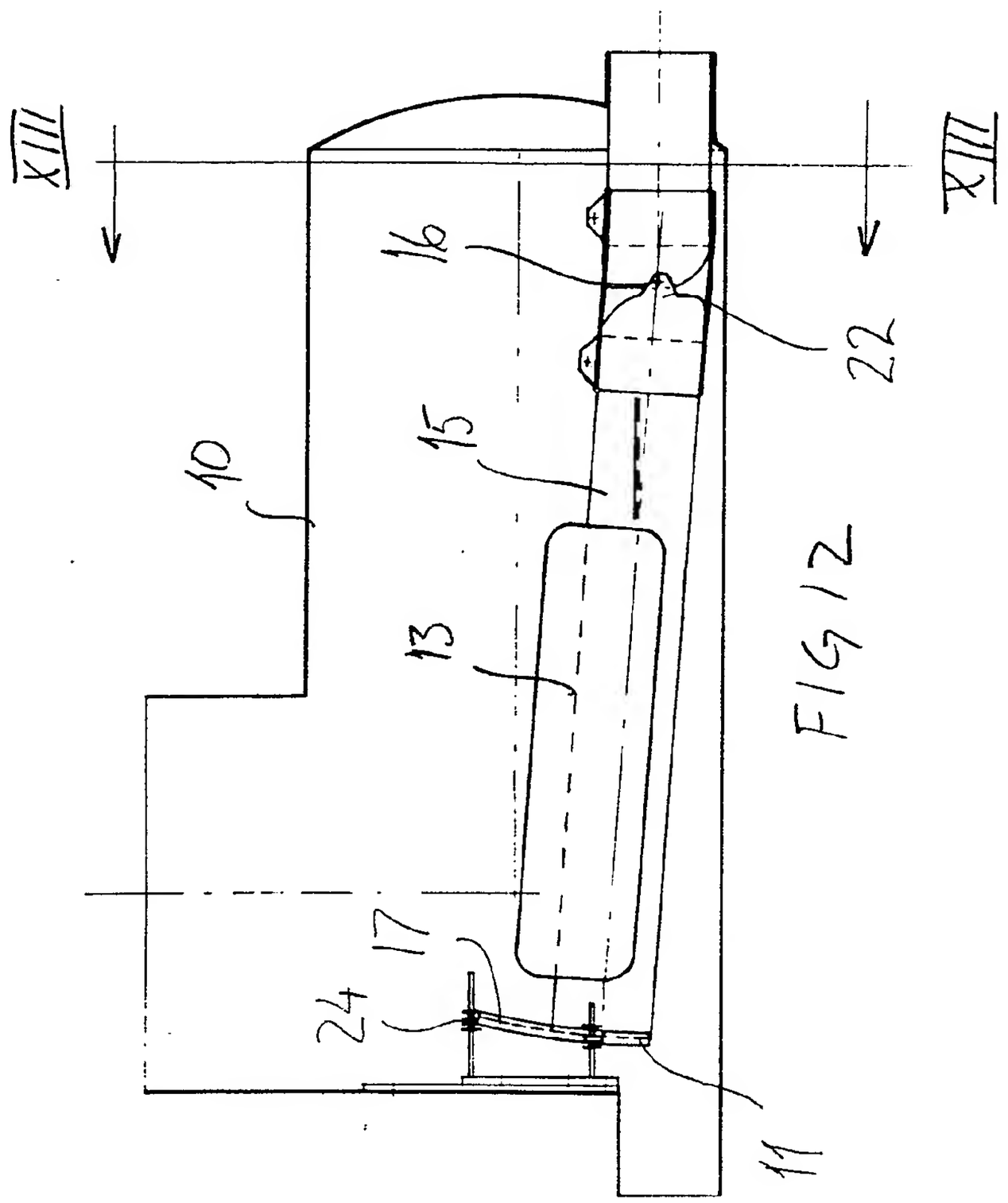

FIG 12

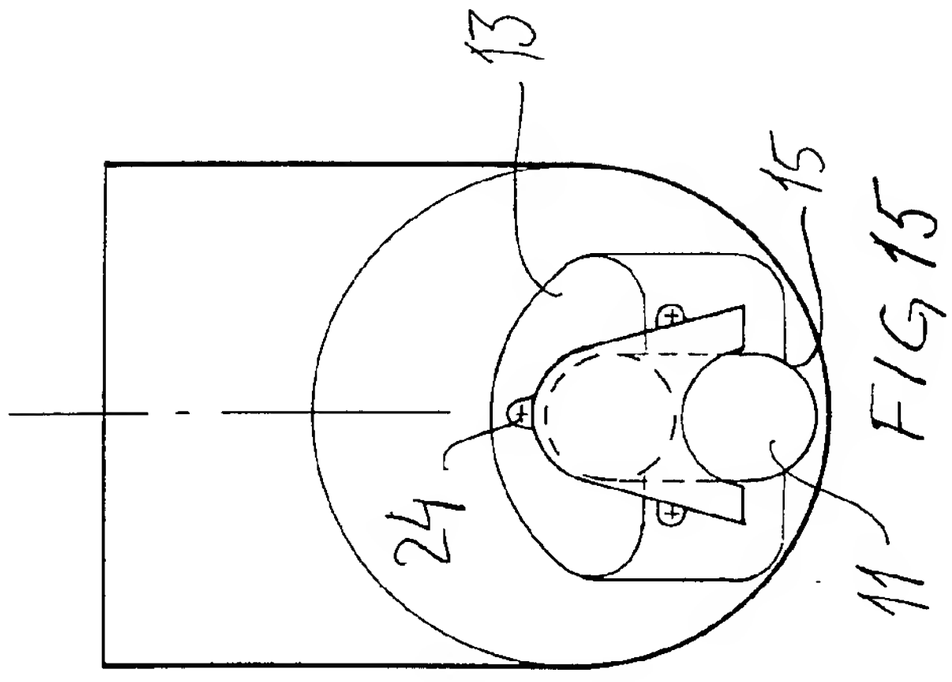

FIG 15

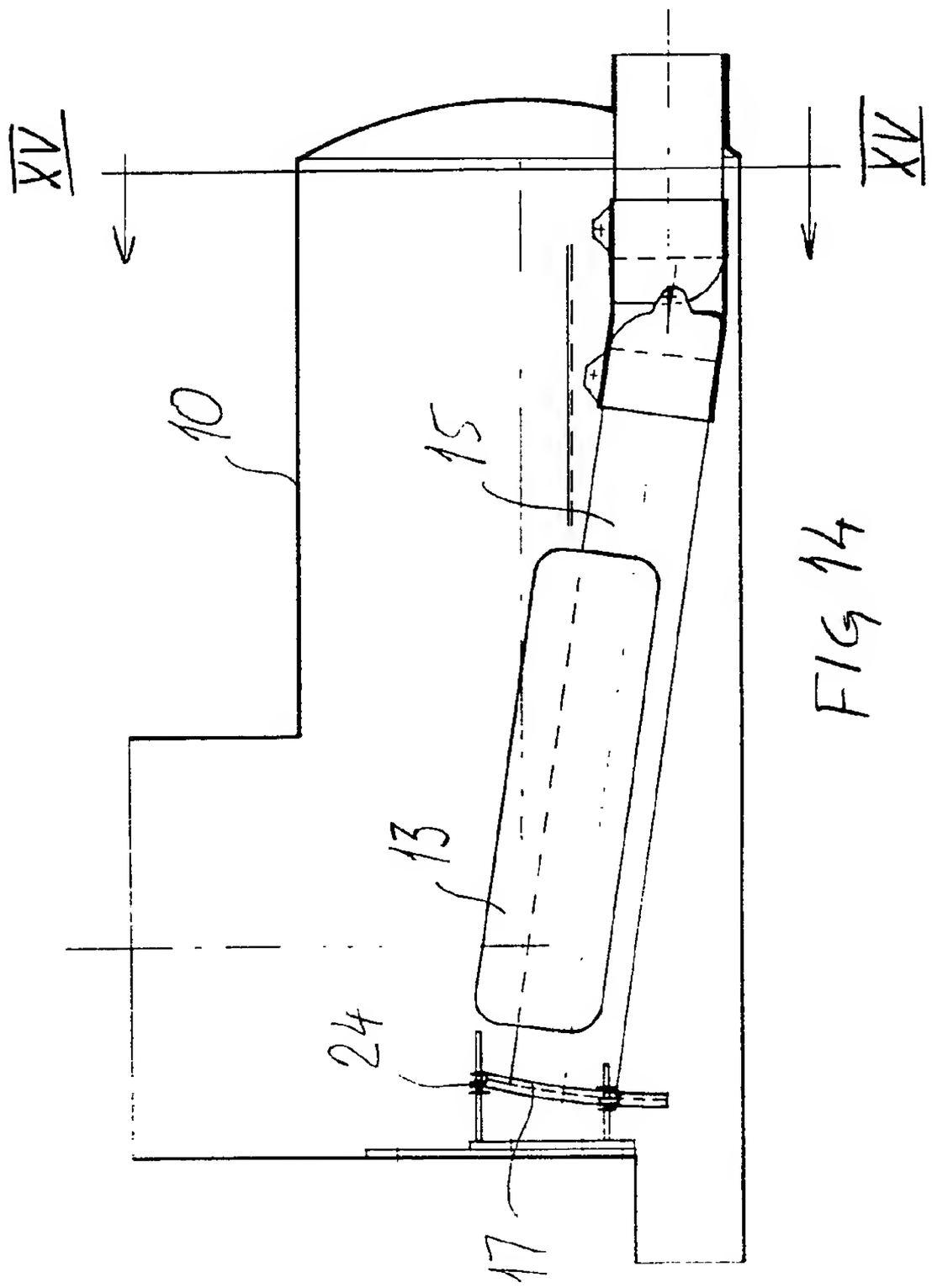

FIG 14

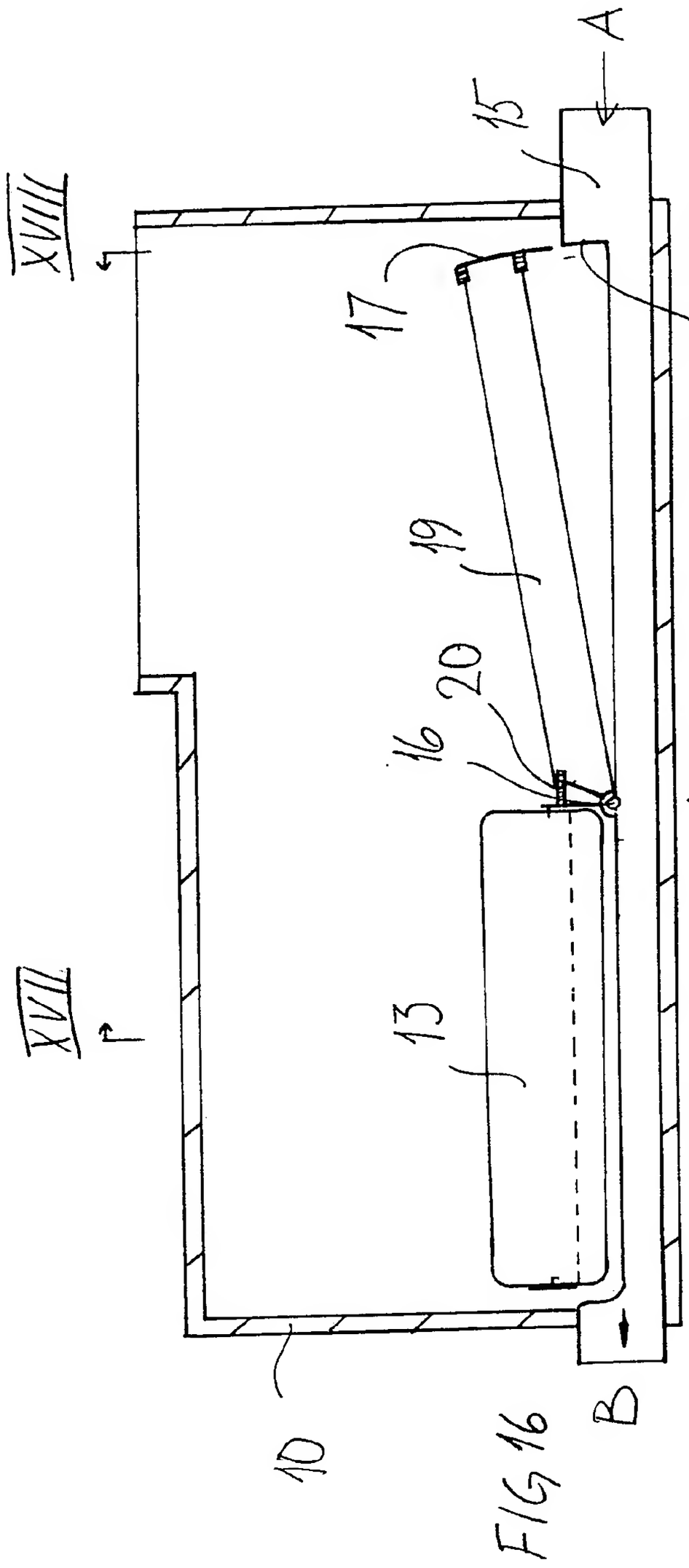

FIG 16

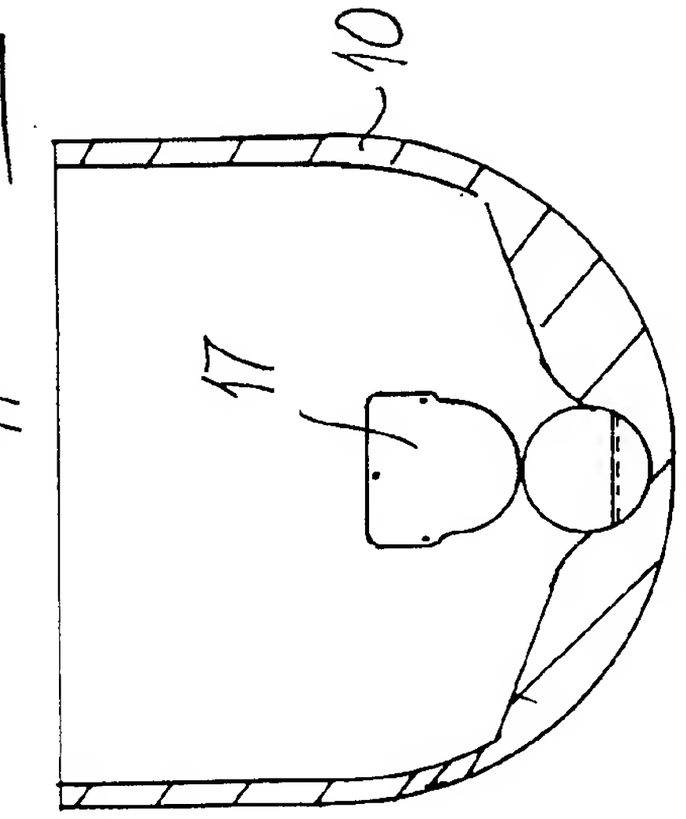

FIG 18

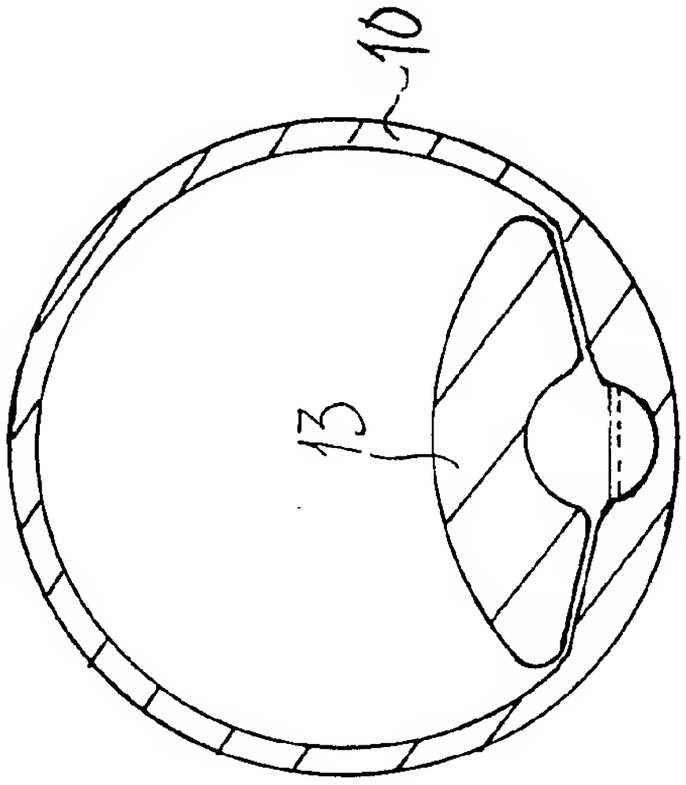

FIG 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 92/00843

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: E03F 5/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: E03F F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4151859 (W. JAKOBI), 1 May 1979 (01.05.79), column 3, line 45 - line 62; column 4, line 10 - line 13 --	1-7
X	DE, A1, 3619318 (KMU GÜNTER KRÜGER ENTWICKLUNG UND HERSTELLUNG VON MASCHINEN), 10 December 1987 (10.12.87), column 1, line 42 - line 44, abstract --	1-7
X	SE, B, 431889 (WILHELM ERNST ET AL), 5 March 1984 (05.03.84), page 21, paragraph 3 - page 22, paragraph 3 --	1-7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 February 1993	04 -03- 1993
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Tommy Blomberg Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

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International application No.
PCT/SE 92/00843

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